

# **KELP FORESTS: NATIVE SPECIES RECOVERY**

by  
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## Abstract

Kelp forest populations in Southern California have been in decline since the 1950s. Since these ecosystems serve important functions for coastal management as well as ecological health of the surrounding marine life, this is a matter of importance. The purpose of this project is to determine if invasive kelp species are to blame for this decline, and if not, what is.

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## TABLE OF CONTENTS

INTRODUCTION/BACKGROUND.....	1
METHOD.....	2
ANALYSIS.....	5
RESULTS.....	6
DISCUSSION.....	7
REFERENCES.....	8

## Introduction/Background

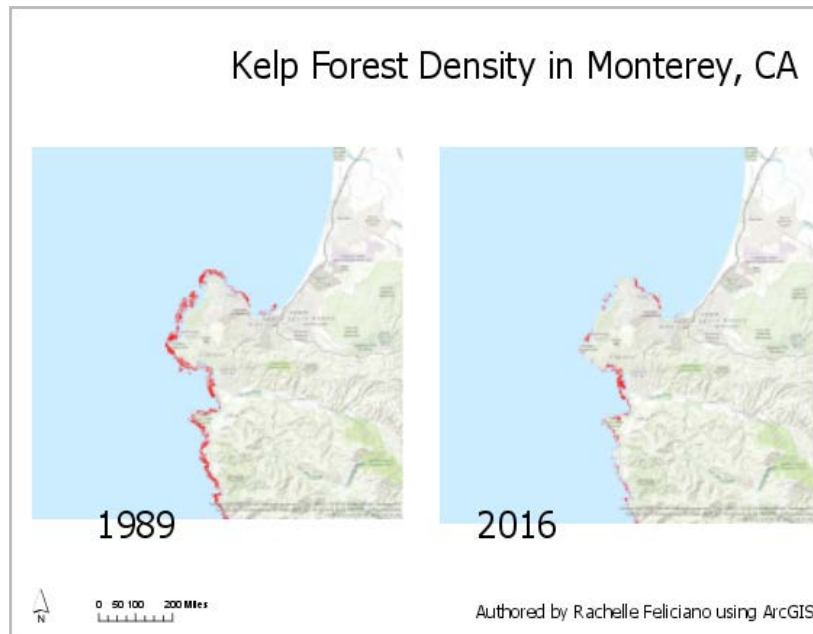
Declining populations of kelp forests is an issue to take seriously. Kelp beds help protect shorelines from wave activity and erosion and provide food and shelter to marine life.

Kelp forests off the coast of California have been in decline in the last 20 years. Although many factors may have taken part, the threat of an invasive kelp species may present issue (Coomber 2017). The primary focus of the project is to research the factors that lead to the California kelp forests' decline and what needs to happen for native species to fight back and regain numbers. And to research invasive species of Asian kelp (*Undaria pinnatifida* and *Sargassum horneri*) and the effects colonies of the two are having on native colonies off the California coast.

Invasive species like Asian kelp out-compete native species for resources. In this case, the kelp forests in California are at risk. Kelp forests off the coast of California are home to a variety of marine life. Without the protection of the kelp forests, these creatures would not have the food or shelter they need to thrive, and would thus, need to seek resources elsewhere.

## Method

Different factors can be considered when looking at the increasing or decreasing populations of native kelp forests in California. First, consider the kelp forest densities as a whole.



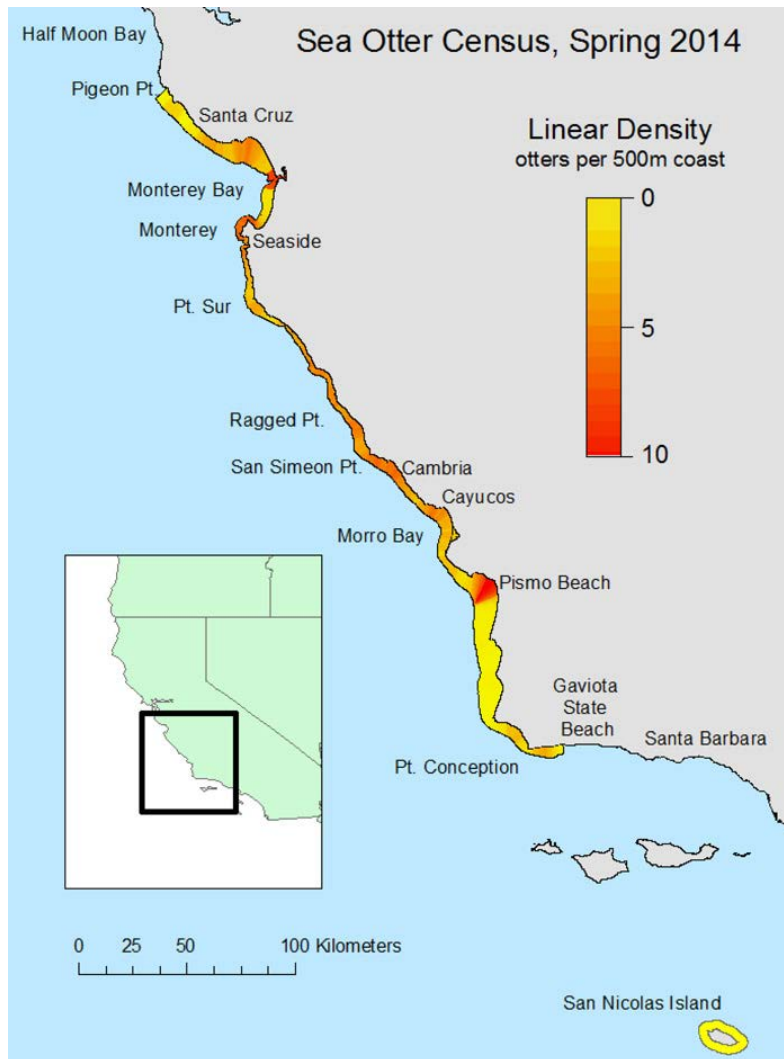
**Figure 1:** Kelp Density Comparison. This data was downloaded from the California Department of Fish and Wildlife. (Source: [ftp://ftp.dfg.ca.gov/R7\\_MR/BIOLOGICAL/](ftp://ftp.dfg.ca.gov/R7_MR/BIOLOGICAL/))

Figure 1 above shows the difference in overall kelp population presence off the coast of Monterey, CA. The significant decline in population shown in the plots implies a change in the kelp environment. To establish the most plausible cause of this decline, the other numerous factors must first be eliminated.

Sea urchins, for example, have been known to be a cause of decline in the health of a kelp forest. Kelp forests in Southern California experienced a severe decline in density

between 1950 and 1970. During this time, there was a loss of prominent sea urchin natural predators. This was due to “overfishing of sea urchin predators (sheephead wrasse and spiny lobsters) and competitors (abalone), ... the kelp forests recovered but are currently sustained as a result of a commercial sea urchin fishery that began in the early 1970s,” (Foster, 2010). This led to the issue of overgrazing by urchin colonies. Sea urchins feed on the holdfasts of kelp and can cause, what are known as “barrens”. Barrens are the thin to bare plots of the ocean floor where a kelp forest once thrived. What is left behind resembles, what one might call a sea urchin garden. With the right balance of grazing and growth, a kelp forest can thrive and remain healthy. However, as with any ecosystem, if one out-populates the other, recovery can be difficult (Eurich et al 2014). Even if kelp were able to repopulate in the area, the chances of becoming a lush forest is not possible if sea urchins are feeding on their holdfasts before given the opportunity to grow. Removal of sea urchins with fishing and collection programs have shown to be promising in areas such as Spain (Eurich et al 2014), however, natural predation of the sea urchins would seem to be the most effective approach to the issue.

As previously mentioned, Spiny Lobsters have been known to feed on sea urchins. However, according to Eurich’s study, lobsters seemed to prefer sea urchins that fed on healthy kelp forests, rather than on urchins from a barren. The California Sea Otter is perhaps the most well-known predator of the sea urchins. Unfortunately, the otter population is also in need of recovery. According to Ben Landis of USGS, because of a history of hunting otters for their pelts, the otter population were thought to be extinct until they were resighted in the area in the 1930s. There were said to be as few as 50 at the time (Landis, 2014).



**Figure 2:** Sea Otter Census 2014. (Source: <https://news.ucsc.edu/2014/09/sea-otter-population.html>)

Figure 2 shows sea otter population numbers off the coast of California. Notice the yellow to orange color in the Monterey area. This indicates 0-5 otters per 500m of coast. This seems to follow information depicted in Figure 1. However, since according to Landis, the sea otter population has been recovering since before the 1930s, the sea otter population does not then seem to be a factor in the decline of kelp density seen since 1989.

## Analysis

*Undaria pinnatifida* (also known as wakame or undaria) is a highly resilient, edible strain of seaweed. According to Laubach, wakame reproduce through spores making it easy to multiply, and hard to control. Wakame are good travelers and often “hitchhike” on anything in the water. This is likely how it traveled from its native Southeast Asian region to California waters.

“Once it gets out there, undaria outcompetes the native kelp that some fish need for shelter, food and egg-laying. The potential impacts of a ballooning undaria population threaten the underwater ecosystem of the Bay and the larger estuary,” (Laubach 2012). Laubach goes on to say the invasive kelp is also bad for businesses, saying “Aquaculture has taken a hit from undaria infestations in Argentina and the Netherlands,” (Laubach 2012). The same can occur for aquacultures in California.

According to Chela Zabin et al, the best time for native species to out-compete undaria individuals is during the summer, when the sporophyte stage of undaria dies back (Zabin 2009). This is mainly to do with shade. Undaria grows most during the sporophyte stage versus the gametophyte stage. Undaria also grow in seasons, whereas the native kelp in California are mostly year round. However, if larger individuals of undaria are present, they may still out-compete native colonies.



According to Foster's study, there were notable declines in localized kelp forests in Southern California, namely Los Angeles and San Diego, rather than a widespread loss throughout the state. In Foster's study, they looked at surface kelp canopy metrics as a way of comparing abundance data. Specifically, Foster referenced numbers for kelp forests in both Los Angeles and San Diego. They also used kelp harvesting data to surmise individual kelp data. According to Foster's results, kelp canopy cover decreased with El Niño events. Giant kelp growth is inhibited during these events due to increased water temperatures and low nutrients. Foster asserts that the "kelp losses were caused primarily by large increases in contaminated sewage discharged into coastal waters, sedimentation from coastal development, and the 1957–1959 El Niño. ... The forests recovered when sewage treatment improved and sewage outfalls were relocated," (Foster 2010). Foster goes on to say that regardless of management of species or protection from loss of predators, kelp forests will not thrive in waters with degrading water quality from contamination and sedimentation. "We conclude that management by species' protection or reserves will not be effective if poor habitat quality impacts the ability of giant kelp to survive and thrive," (Foster 2010). This also implies that regardless of impacts from competition of invasive kelp species, native kelp species will not recover unless conditions improve.

## Results

Based on the research presented, the decline of the kelp forests in California may have largely to do with other environmental factors than solely competition with the invasive *Undaria Pinnatifida*. If native colonies were to recover, water quality would first have to

improve for the area. This would ensure a healthy, established environment for the native colonies. Removal of invasive undaria would help in less competition for the kelp as well. Other factors such as sea urchin populations and sea otter recovery would also aid in the effort, but mainly for overall health of the food web. This is largely supported by Foster's study regarding surface kelp canopies in Los Angeles and San Diego.

## Discussion

Removal efforts of undaria have been revived thanks to new funding in the San Francisco area. Chelsea Zabin of the Smithsonian Environmental Research Center has effectively established an organization targeting the undaria and other invasive species issues in known areas in the San Francisco region called Bay Area Early Detection Network. "At the 2011 State of the Estuary conference, Zabin approached the BAEDN about working together on the undaria removal project. BAEDN applies a systematic approach to tackling invasive species, beginning with cataloguing where the invasive is present and prioritizing what areas should be worked on first," (Laubach 2012). Zabin continues to say this approach could help in managing other marine invasive species everywhere. Since undaria is edible, other efforts to control the invasive species include raising demand and encouraging the public to eat the popular sushi topping (Roman 2013). Although it sounds promising, Zabin does not endorse the idea for the plants she pulls during management dives, and instead opts to place the undaria in garden composts. This is largely due to many of the areas are in contaminated or sewage water, not in an aquaculture (Laubach 2012).

## Kelp Density Data

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